

processing method and apparatus by which it becomes possible to heat a substrate to be processed to a predetermined temperature in a short period and also possible to supply the substrate with a processing fluid uniformly to accomplish the improvement in throughput and the homogenization in processing.

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In order to attain the above object to be solved, according to an invention ~~stated in claim 1~~, a substrate processing method for heating a substrate to be processed to a predetermined temperature, the substrate being held by holder and also accommodated in a processing container equipped with heater, and further processing the substrate to be processed while supplying a processing fluid into the processing container, the method comprises the steps of: moving the substrate to be processed close to a heating surface of the heater relatively thereby to heat the substrate to be processed to a processing temperature; moving the substrate to be processed apart from the heating surface of the heater to a processing position after heating the substrate to the processing temperature; and supplying the processing fluid into the processing container.

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According to an invention ~~stated in claim 2~~, the substrate processing method further comprises the steps of: making the holder receive the substrate transferred from the exterior of the processing container at a delivery position before bring the substrate and the heating surface of the heater into relative closer relationship; and discharging the processing fluid for processing from the interior of the processing container after supplying the processing fluid into the processing container.

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According to an invention ~~stated in claim 3~~, in the step of supplying the processing fluid into the processing container, the holder and the heating surface of the heater are relatively moved close to and apart

from each other intermittently or continuously.

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According to an invention ~~stated in claim 4~~, the substrate processing method further comprises the steps of: opening a lid body forming the processing container  
5 before making the holder receive the substrate at the delivery position; closing the lid body after bring the substrate and the heating surface of the heater into relative closer relationship and before a temperature of the substrate reaches to the processing temperature; and  
10 after discharging the processing fluid for processing from the interior of the processing container, again opening the lid body, transferring the substrate from the processing position to the delivery position and unloading the substrate out of the processing container.

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15 According to an invention ~~stated in claim 5~~, the holder is capable of moving in and out of a processing chamber thereby plunging into the processing chamber through the processing container, the substrate to be processed is supported by the holder horizontally, and  
20 the holder is moved vertically to make the holder and the heating surface of the heater close to and apart from each other relatively.

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According to an invention ~~stated in claim 6~~, the flowing direction of the processing fluid in a  
25 processing chamber is generally perpendicular to the close-and-apart moving direction of the holder and the heating surface of the heater.

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According to an invention ~~stated in claim 7~~, the processing fluid is supplied so as to diffuse in the  
30 plane direction of the substrate arranged in the processing container and further bypass in a direction generally perpendicular to a diffusing surface of the substrate.

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35 According to an invention ~~stated in claim 8~~, a substrate processing apparatus comprises: a processing container for accommodating a substrate to be processed,

the processing container having a supply port for supplying a processing fluid into the processing container; holder for holding the substrate in the processing container; heater provided to the processing container for heating the substrate to a predetermined temperature; a supply pipeline connected to the supply port; valve interposed in the supply pipeline; a processing fluid source for supplying the processing fluid into the processing container through the supply pipeline; close-and-apart moving mechanism for moving the substrate held by the holder close to or apart from a heating surface of the heater relatively; and controller for controlling the close-and-apart motion of the close-and-apart moving mechanism and the open-and-close operation of the valve.

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Stf 9/15/05 According to an invention ~~stated in claim 9~~, the substrate processing apparatus further comprises a connecting member arranged outside the processing container, wherein the holder includes a plurality of holding rods arranged so as to penetrate the processing container movably in a fluid-tight manner through a through-hole formed in the processing container and project into the processing container; and holding members arranged at respective tips of the holding rods to support the underside of the periphery of the substrate thereby holding it horizontally, and wherein the holding rods are connected, at their parts outside the processing container, with the close-and-apart moving mechanism through the connecting member.

Stf 9/18/05 30 According to an invention ~~stated in claim 10~~, each of the holding members has a holding part for supporting the lower surface of the periphery of the substrate and a standing part formed to stand upwardly from the outer portion of the holding part over the upper surface of the substrate, the standing part having an inside surface inclined to the holding part so as to gradually

reduce a thickness between the inside surface of the standing part and the outer circumference of the standing part as directing upward.

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5 According to an invention<sup>1</sup>~~stated in claim 11~~, the close-and-apart moving mechanism includes a motor rotatable in both direction and a ball screw mechanism having a converting part to convert the rotational movement of the motor to a linear movement.

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10 According to an invention<sup>2</sup>~~stated in claim 12~~, the controller controls the close-and-apart moving mechanism in a manner that the substrate to be processed moves to a delivery position where the substrate is delivered into the processing container, an adjacent position where the substrate is opposed to the heating surface of  
15 the heater and a processing position where the substrate is apart from the heating surface of the heater over the adjacent position, and further controls the opening-and-closing operation of the valve in the supply pipeline in order to supply the substrate at the processing position  
20 with the processing fluid.

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According to an invention<sup>3</sup>~~stated in claim 13~~, the controller further controls the close-and-apart moving mechanism in a manner that the substrate at the processing position moves close to and apart from the  
25 heating surface of the heater intermittently or continuously.

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According to an invention<sup>4</sup>~~stated in claim 14~~, the processing container has a container body and a lid body, the heater is arranged in a horizontal bottom part of  
30 the container body forming the heating surface, the processing container has a fluid supply port and a drain port formed at opposing parts of a sidewall standing from the periphery of the horizontal bottom part, and the lid body is movable up and down in the vertical  
35 direction and also adapted so as to close an opening of the container body through a seal member.

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According to an invention ~~stated in claim 15~~, the processing container includes a container body having its horizontal bottom part provided with the heater to form the heating surface, the container body having a fluid supply port and a drain port for the processing fluid, and a lid body that is movable up and down and is adapted so as to close an opening of the container body through a seal member, and the moving of the substrate between the adjacent position and the processing position is carried out under condition that the container body is closed by the lid body.

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According to an invention ~~stated in claim 16~~, the processing container has a communication path to communicate the fluid supply port with the interior of the processing container, the communication path having a bypass part having a diffusion groove extending from the fluid supply port to both sides thereof and a sagging piece plunging into the diffusion groove.

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According to an invention ~~stated in claim 17~~, the lid body further includes another heater.

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According to the invention ~~stated in claims 1, 2, 8, 9, 11 and 12~~, by making the substrate to be processed approach the heating surface of the heater relatively and heating the substrate to the processing temperature while holding the substrate by the holder, it is possible to heat the substrate to the processing temperature in a short time. Then, after heating the substrate to the processing temperature, by separating the substrate from the heating surface of the heater to the processing position and further supplying the processing chamber of the processing container with the processing fluid, it is possible to supply the processing fluid uniformly. According to the inventions

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~~stated in claims 3 and 13~~, by relatively moving the holder and the heating surface of the heater close to and apart from each other intermittently or continuously

while supplying the processing chamber with the processing fluid, it is possible to make smooth approach of the processing fluid to both sides of the substrate and also possible to supply the processing fluid more  
5 uniformly.

Stf 9/8/05 Further, according to the inventions stated in <sup>e</sup>  
~~claims 6 and 14~~, by moving the holder and the heating surface of the heater closer and farther in a direction generally perpendicular to the flowing direction of the  
10 processing fluid, it is possible to make the approach of the processing fluid to both sides of the substrate smoother. According to the inventions stated in ~~claims 7~~<sup>e</sup>

Stf 9/8/05 ~~and 16~~, by diffusing the processing fluid in the plane direction of the substrate in the processing container  
15 and further bypassing the processing fluid in a direction generally perpendicular to a diffusing surface of the substrate, it is possible to supply the substrate with the processing fluid uniformly.

Stf 9/8/05 Further, according to the inventions stated in <sup>c</sup>  
20 ~~claim 14 and 15~~, the processing container comprises the container body having its horizontal bottom part provided with the heater to form the heating surface, the container body having the fluid supply port and the drain port for the processing fluid, and the lid body  
25 that is movable up and down in the vertical direction of the substrate processing apparatus and is adapted so as to close an opening of the container body through the seal member, and the moving of the substrate between the adjacent position and the processing position is carried  
30 out under condition that the container body is closed by the lid body. Consequently, the withdrawal of the lid body from the container body allows the substrate to be transferred from the outside to the holder with ease. When processing the substrate, it is possible to  
35 insulate the processing chamber from the outside by closing the opening of the container body by the lid